AD-A060 360   ARMY TROOP SUPPORT AND AVIATION MATERIEL READINESS CO--ETC   F/G 5/1
MANOVA: A METHODOLOGY FOR FORECASTING MANPOWER DEMANDS.(U)
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USATSARCOM

TECHNICAL REPORT 78-8

MANOVA: A METHODOLOGY FOR FORECASTING MANPOWER DEMANDS

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BLAINE T. STONE

SEPTEMBER 1978

Final Report

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER
USATSARCOM Technical Report 78-8

2. GOVT ACCESSION NO.

3. RECIPIENT'S CATALOG NUMBER

4. TITLE (and Subtitle)
6 MANOVA: A Methodology for Forecasting Manpower Demands.

5. TYPE OF REPORT & PERIOD COVERED
9 Final rept.,

6. PERFORMING ORG. REPORT NUMBER

7. AUTHOR(s)
10 Frank A./Blackshear
Blaine T./Stone

8. CONTRACT OR GRANT NUMBER(s)
12 64p.

9. PERFORMING ORGANIZATION NAME AND ADDRESS
HQ, US Army Troop Support and Aviation Materiel Readiness Command, 4300 Goodfellow Blvd., St. Louis, MO 63120

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS

11. CONTROLLING OFFICE NAME AND ADDRESS
Directorate for Plans and Systems Analysis, Systems Analysis Division, 4300 Goodfellow Blvd., St. Louis, MO 63120

12. REPORT DATE
11 Sep[redacted]78

13. NUMBER OF PAGES
62

14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)
14 TSARCOM-78-8

15. SECURITY CLASS. (of this report)
UNCLASSIFIED

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for Public Release; distribution unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Regression Analysis; Manpower; Management Engineering; Forecasting; Curve Fitting

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The procedures described in this paper are primarily intended to illustrate methods of simple linear and curvilinear regression analysis with special emphasis on the cause vs effect relationships between manpower and workload indicators. Statistics include confidence intervals for the regression coefficients, analysis of variance and hypothesis testing, among other relevant qualifying parameters.

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

TABLE OF CONTENTS

I. Introduction

During an executive session of a Commanders' Conference hosted by the Missile Materiel Readiness Command (MIRCOM) on 13-15 June 1978, the subject of a manpower and work load analysis was discussed. Several commanders suggested to the Chief of Systems Analysis Division, HQ, DARCOM, that an investigative study to examine historical trends in manpower and work load has considerable merit and potential economic benefit. The aim at HQ, DARCOM, is to examine all of their important work generating functions. Most of the functions performed here at TSARCOM have dimensions and are quantifiable. Because these functions are quantifiable, they can be measured, to an acceptable level of confidence, by classical mathematical methodology and analysis. The expectation is imminently optimistic that valid and persuasive relationships can be developed to track trends in work load and associated manpower needs. Where work measurement standards are available, these data will be used in the analysis. In the absence of these kinds of data reports, trend analysis, ratio analysis, linear and multi-variate correlation and regression techniques are among the suggested methodologies to be used. In areas less susceptible to quantitative analysis, professional and mature judgement may be employed through the use of Delphi iterations or other proven schemes.

II. Purpose and Objective

The purpose of MANOVA, a manpower analysis of variance, is to present a comprehensive mathematical methodology designed to facilitate establishment of a statistical baseline for measuring manpower levels associated with work load dependence. Imminently, the objective of this report is preliminary and brief in establishing a functional manpower model. This treatment is subject to expansion provided the need for statistical designs of manpower analysis becomes evolutionary upgraded.

III. Scope and Applicability

The procedures described in this paper are primarily intended to illustrate methods of correlation and regression analysis with special emphasis on the relationship between manpower and work load parameters. The techniques provide useful information for decision making, but the models will not make a decision for the decision maker. In this abbreviated treatment of manpower modeling, several of the statistical parameters which serve to add relevant significance to the various regression equations are included. These statistics include confidence intervals for the regression coefficient or slope of the curve, analysis of variance, and hypothesis testing. This paper will examine the significance of the correlation coefficient and the standard error of the estimate of the independent variable (X, or work load) on the dependent variable (Y, or manpower). The methodology is intended to support and defend the DARCOM Baseline Study for conducting applicable manpower analyses within TSARCOM.

IV. METHODOLOGY

A. Consideration to the Approach. Operational effectiveness of the US Army Troop Support and Aviation Materiel Readiness Command (TSARCOM) on any functional organization is increased by finding better ways of doing work. The implication in this rather obvious premise is that better ways of doing work are accomplished by managing the use of physical and human resources while minimizing cost or manpower expenditure. Management engineering studies of the type presented herein attempt, through analytical and scientific means, to provide top level management with a sound baseline of manpower vs workload factors whereby quality manpower allocation and economic decisions may be made. During this preliminary phase of the DARCOM Baseline Study, several alternative methods are available to analyze the relationship between manpower expenditure and the quantity of units produced. Some techniques which were suggested by HQ, DARCOM, include:

(1) Trend Analysis.

(2) Ratio Analysis.

(3) Linear Correlation and Regression Analysis.

(4) Multi-variate Correlation and Regression Analysis.

(5) Other.

Under the category of "Other," the authors have examined the following mathematical and statistical methodologies.

(1) Exponential Smoothing.

(2) Bayes' Theorem.

(3) Bivariate Curve of Best Fit Correlation and Regression, Linear and Curvilinear.

The method proposed by the authors to be superior in measuring relationships between manpower and workload for troop support and aviation system managed items is Simple Regression, Linear and Curvilinear. We support this selection by rationale for eliminating all of the above and setting forth our rationale for selecting Simple Regression, Linear and Curvilinear.

Trend Analysis is essentially a set of observations taken at specified times, usually at equal intervals. The dominate characteristic prevailing in this type of analysis is time dependency. Its strongest attributes are grounded in situations where there exists well defined secular variations, cyclical oscillations, seasonal variations, and random occurances such as acts of nature, strikes, elections, etc. TSARCOM data bases are not compiled in sufficient detail to attempt this kind of manpower analysis. Eliminate this alternative.

Ratio Analysis is very similar in characteristics to Trend Analysis. In this method, data for each month are expressed as percentages of monthly trend values. This concept is extremely laborious and inaccurate since too much of the data are adjusted to approximations, thereby introducing extraneous errors. Simply stated, if the mean values of the sample data are not 100%, some arbitrary factor must be introducted to adjust the data. Eliminate this alternative.

Linear Correlation and Regression Analysis is by far the most superior method of the previous two. However, an assumption must be made in this kind of technique that all data distributions will adjust to a straight line or result in a linear best fit pattern. The assumption associated with this method is too arbitrary. Eliminate this alternative.

Multi-variate Correlation and Regression Analysis is indeed a classical and value-proven statistical scheme. This concept considers the relationship of three or more independent variables acting on a single dependent variable. For example, one might attempt to measure the total relationship of manpower in terms of work units such as the number of travel vouchers processed, travel orders initiated, card punch transactions to process travel payment, the number of completed travel assignments and the number of aborted

travel assignments. Under such a mix of variables (independent though they may seem), the notion that one or more of these "independent" variables is indeed dependent on each the other is very imminent. This concept of interdependency is called autocorrelation. And, while there are techniques to test for and adjust autocorrelation residuals, the technique of multicorrelation and regression is too time consuming and risky for an investigation of magnitude such as the DARCOM Baseline Study. Eliminate this alternative.

Exponential Smoothing is a discrete time series forecasting scheme. In this kind of analysis, the data must be extremely accurate and some pre-planned data collection and recording system must be in existence before this procedure can be accurately manipulated. Also, the derived mathematical equations make use of a "smoothing constant." This smoothing constant is essentially a variable weighting factor assigned to selected parameters in the mathematical equation. Indeed, the smoothing constant is the most critical variable in the entire scheme. The criteria for selection of a smoothing constant is fundamentally judgemental therefore arbitrary. Because the smoothing constant is derived by heuristic means, the forecast resulting from this methodology

is often viewed with skepticism by high level decision makers. Mutual fund companies use this methodology to forecast earnings. Eliminate this alternative.

Bayes Theorem, a probabalistic method, is beyond the scope of consideration although it is perhaps the most precise of all the methods to predict probable occurrences. Its application is highly complex and the TSARCOM data base could not support this kind of classical treatment. It is only mentioned here so that the reader will be aware that the use of the Bayesian property has been considered.

Finally, we reach the method of simple Bivariate Regression, Linear and Curvilinear. This method examines the relationship of one independent variable (work load factors) and one dependent variable (manpower) from historical data, and a curve or model of best fit is generated which in turn describes the data in six equations. For purposes of this paper, we will discuss only four curve fitting equations. They are the:

(1) Linear or Straight Line Function.

(2) Exponential Function.

(3) Parabolic Function.

(4) Power Function.

For an examination of these four "curve of best fit options" if the data correlates to a prescribed standard (usually a minimum of 70%), we select the equation which best explains the behavior of our data as we have experienced and recorded it. Then, if our history is recorded accurately and stratified in sufficient invervals (say monthly), we arrive at a baseline from which we can extrapolate or project future manpower/workload scenarios. By this method, using selected statistical parameters, we are able to associate levels of confidence in the degree of fit which the mathematical equation describes. While this method is most adaptable to support the TSARCOM data base, there are caveats associated with its use. Some of these caveats are:

(1) It is a statistical model as opposed to a deterministic model. Therefore, it is not exact and it must be interpreted in the fact.

(2) Care must be exercised by the user to insure that the input variables do indeed correlate. Quite often, numbers selected at random will show high correlation when in fact they do not have cause-effect relationships. This method is not adequately sensitive to reject this kind of misintended data.

(3) Interpreting and documenting the results must be clearly annotated.

(4) There are strict limitations on "how far out" data can accurately be forecast.

(5) Almost without exception, the object of a statistical study is to furnish a basis for generalization.

Nevertheless, the strong point is that the proposed method has a high degree of credibility in spite of the caveats of which we are aware. The fact that we are aware of the caveats is the first strong point in our favor. Since 1968, the Air Force has used this method with success in its management engineering procedures. (See AFM 25-5, Management Engineering Procedures, 7 June 1968). US Army Aviation Systems Command, under contractual consulting services with Washington University, St. Louis, MO, used this method with success in a manpower study conducted in 1968 and 1969. The DESCOM Baseline Study of 1978 used the concepts of this methodology. From a practical implementation viewpoint, there are several advantages for TSARCOM in using this methodology. They are:

(1) Analysts are familiar with the method and have the analytical experience.

(2) Computer programs are available within the Scientific and Engineering (S&E) computer system (IBM 360/65).

(3) A computer program is available for partial printout (testing) and graph platting on TSARCOM's mini-computer, the Hewelet Packard 9810.

(4) The proposed data base is accessible for exercising this model.

(5) The procedure is easy to explain to high level decision makers.

(6) There is total in-house capability to support the study logistics.

(7) The International Mathematical Statistical Library (IMSL), which is available in our Directorate for Management Information Systems, has full documentation and proven test cases for most of the mathematical formulation for this methodology.

(8) The procedure is upwardly compatible for updating as new data becomes available.

(9) Autocorrelation effects are eliminated.

B. <u>Simple Regression, Linear and Curvilinear</u>. The first step in correlation and regression modeling is logically to select, collect and compile the data. This step results in the construction of a scatter diagram. The scatter diagram will save time by allowing visual elimination of obviously

unacceptable or implausible relationships. The next step is to process the data through a computer program. This output will result in a set of parameters by which we can determine which one of four mathematical equations to select for the analysis or to reject all four. This first selection of degree of fit will be based on the standard error of the estimate, the coefficient of correlation and the index of determination. The four mathematical models will be a linear function, an exponential functional, a parabolic function and a power function. General equations describing each of these functions are shown in the Hypothetical Case, paragraph C, below. Once a particular function (equation) is selected as best fit of the data, extrapolating or extending the regression equation is accomplished. There are limitations to which the regression equations are constrained. Mathematical deviations describing each model will not be presented in this paper. Most mathematical statistics textbooks contain the derivation. In general, the best model to select from this methodology is the one with the least standard error of the estimate, the highest index of determination and the highest correlation coefficient. All this being the case, in selecting the best model, management must take into consideration (in addition to the statistical criteria), those judgemental considerations

and real world factors which a mathematical model cannot quantify.

C. The Hypothetical Case. For the purposes of illustration of this methodology, a hypothetical (short) case is presented. We have manpower spaces and workload units produced over a 10 year period. We wish to execute the Simple Regression, Linear and Curvilinear model to determine the best equation for establishing a baseline for projection. The next pages show the parameters and equations derived from the same data. The computation shows the extrapolation for five projected work load situation years and the number of manpower spaces required to do the forecasted work. Appendices A through F contain details which the more than casual reader might wish to examine.

<u>HYPOTHETICAL DATA BASE</u>

FISCAL YEAR (FY)	MANPOWER (Y)	WORK LOAD (X)
69	2	17
70	3	6
71	4	22
72	4	37
73	5	50
74	6	39
75	7	31
76	7	48
77	7	57
78	8	40

Range (X): 6 - 57
Range (Y): 2 - 8

Mean of X = 34.7
Mean of Y = 5.3
N = 10

Max X = 10
Mzx Y = 60

The four resultant models are:

(1) Linear, $Y = a+bx$, $Y = 2.1707+0.0902(x)$

$r^2 = 0.51$ $r = 0.71$ $Syx = 1.484$ $tc = 2.896$

(2) Exponential, $Y = a(exp)(bx)$, $Y = 2.385exp(0.0278x)$

$r^2 = 0.55$ $r = 0.74$ $Syx = 0.318$ $tc = 3.115$

(3) Parabolic, $Y = a+bx+cx^2$, $Y = 1.1825+0.1721x-0.0013x^2$

$r^2 = 0.54$ $r = 0.73$ $Syx = 1.546$ $tc = 9.267$

(4) Power, $Y = ax^b$, $Y = 0.9889x^{0.4712}$

$r^2 = 0.51$ $r = 0.71$ $Syx = 0.332$ $tc = 2.878$

Graphs of the above curves are shown on pages 17-20.

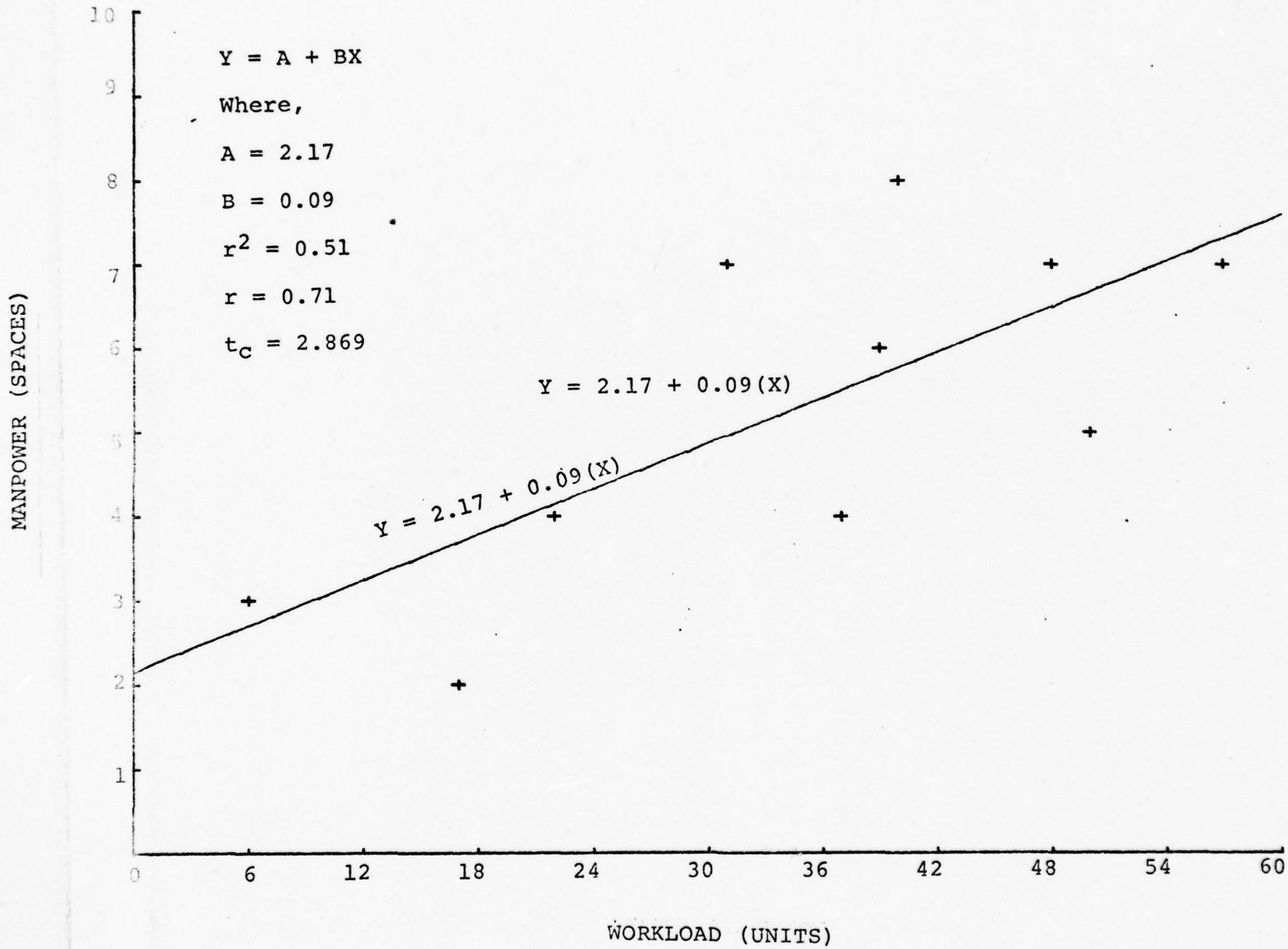
COMPUTATION SUMMARY

FUNCTION	r	Syx	tc	EXTRAPOLATION (X) 60	64	68	72	76
Linear	0.715	1.484	2.896	7	8	8	9	10
Exponential	0.740	0.318	3.115	9	9	10	11	12
Parabolic	0.733	1.546	9.267	7	7	7	7	7
Power	0.713	0.332	2.878	7	8	8	8	8

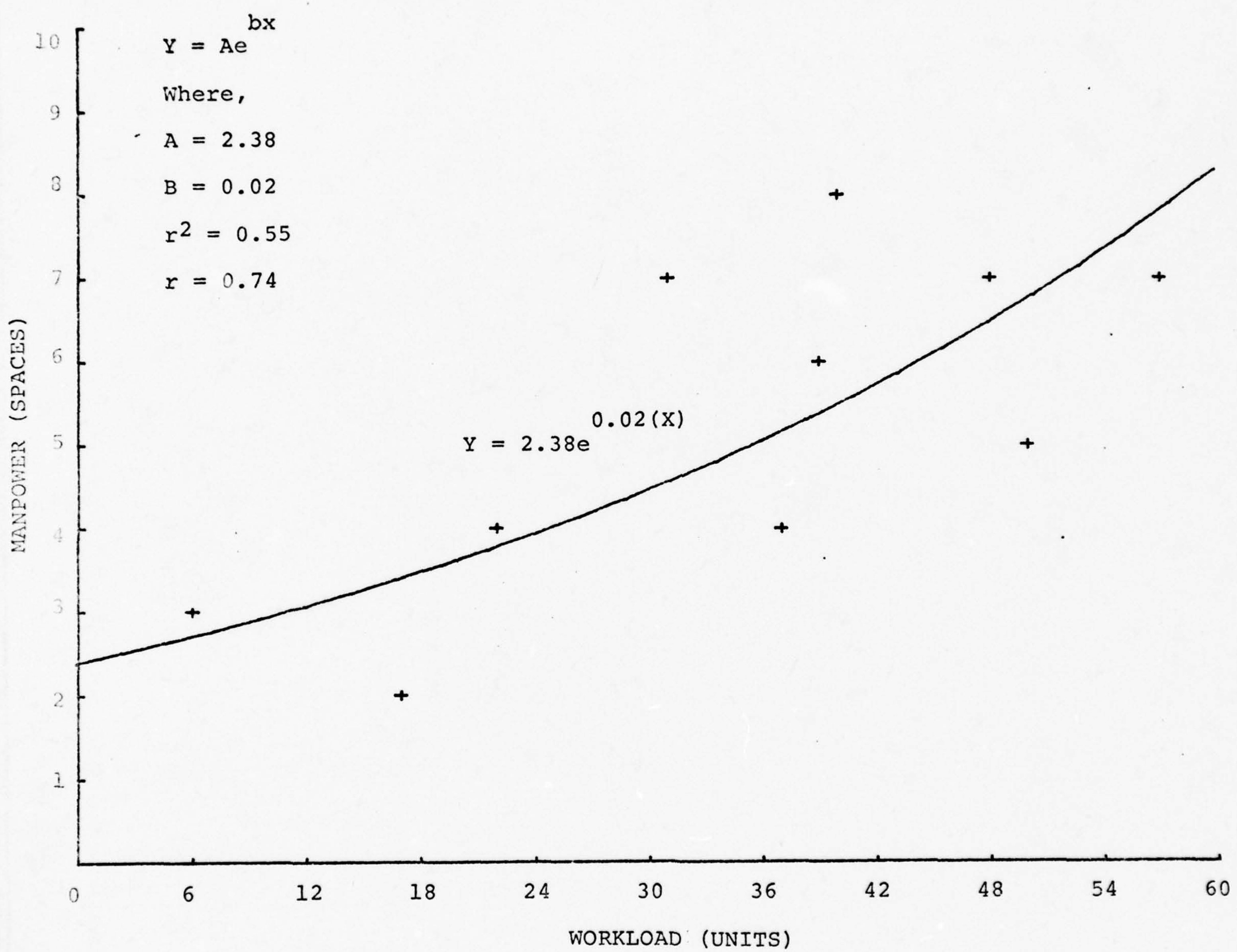
Select Exponential:

(1) Highest Correlation Coefficient (r)
(2) Lowest Standard Error of the Estimate (Syx)
(3) Highest "t" statistic
(4) Interval estimation of slope is smallest (See Appendix D)
(5) The "F" statistic is significant at the 97.5% level

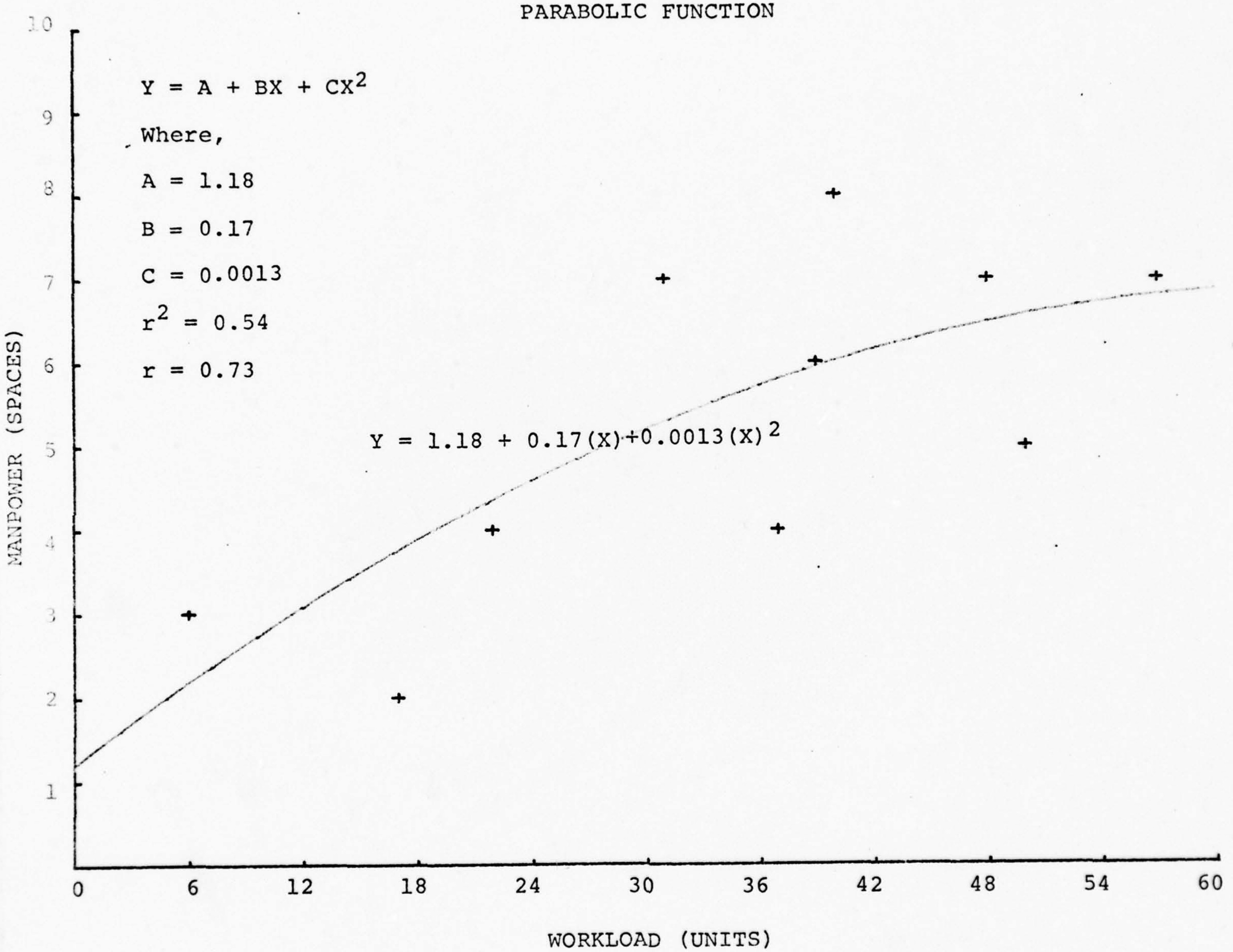
LINEAR FUNCTION



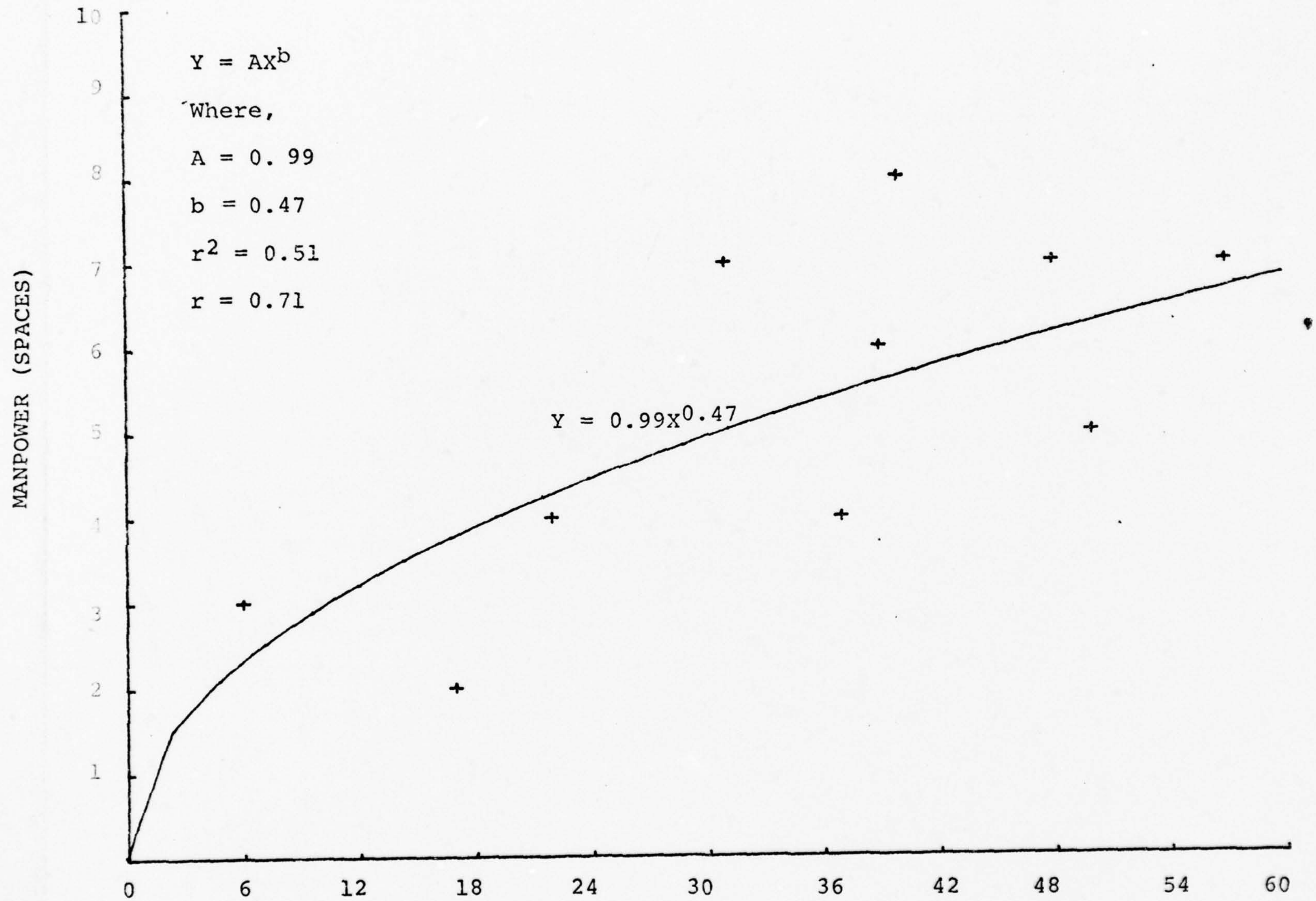
EXPONENTIAL FUNCTION



PARABOLIC FUNCTION



POWER FUNCTION



WORKLOAD (UNITS)

V. Cost Estimating Considerations. From our hypothetical case, we selected the expoential function to be the curve of best fit for this particular data scenario. Let us now give some consideration to the cost estimates associated with this projected manpower proposition. Our source for making cost projections is DRCCP-ER letter, dated 28 Jul 78, subject: Inflation Guidance (Appendix E).

Let us assume that our starting point is the current fiscal year, FY 78. The largest number of people in our data sample is 8. Let us, for simplicity, assume that these 8 people are GS-11's, step 4. The yearly salary for GS-11/4 is $20,085. (General Salary Schedule, Oct 77). The total yearly salary for these 8 people is,

8 * $20,085 = $160,680

Using OSD/OMB inflation guidance, dated 28 July 1978 (Appendix E), Operations and Maintenance compound indices, our cost projections over the next five fiscal years are shown below:

FY 78 8 * $20,085 * 1.000 = $160,680

FY 79 9 * $20,085 * 1.0630 = $192,153

FY 80 9 * $20,085 * 1.1268 = $203,686

FY 81 10 * $20,085 * 1.1944 = $239,895

FY 82 11 * $20,085 * 1.2613 = $278,665

FY 83 12 * $20,085 * 1.3319 = $321,014

The projected (estimated) salary cost to implement this kind of manpower expansion over the five year period, FY 79 - FY 83 is $1,235,413.

VI. Summary. We have presented a comprehensive discussion of several methodologies which might apply to the DARCOM Baseline Study with particular emphasis on TSARCOM's capability to exercise the method. We have selected and proposed one method from those alternatives. It is the method of Simple Regression, Linear and Curvilinear. Further, we have illustrated a simple hypothetical case to show, in general, how the method works. Cost considerations have been illustrated using recognized DoD inflation guidance. Through correlation and regression analysis, we believe we have a statistical technique, which, when properly used with accurate data, will provide TSARCOM management an ordered set of baseline alternatives to complement manpower projection decisions.

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APPENDIX A

SUMMATIONS AND GENERAL RESULTS

SUMMATIONS AND GENERAL RESULTS

$\Sigma X = 347$

$\Sigma X^2 = 14,313$

$\Sigma XY = 2,044$

$\Sigma Y = 53$

$\Sigma Y^2 = 317$

$N = 10$

$\bar{X} = 34.7$

$\bar{Y} = 5.3$

$(\Sigma X)^2 = 120,409$

$(\Sigma Y)^2 = 2,809$

$$\Sigma(X-\bar{X})^2 = 2272.10$$

$$\Sigma(X-\bar{X})^2 = 47.6665$$

$$\Sigma(Y-\bar{Y})^2 = 36.10$$

$$\Sigma(Y-\bar{Y})^2 = 6.0083$$

APPENDIX B

COMPUTATION OF "t" STATISTIC FOR CORRELATION COEFFICIENTS

COMPUTATION OF "t" STATISTIC FOR CORRELATION COEFFICIENT

I. GENERAL

$$tc = r\sqrt{\frac{N-m}{1-r^2}}$$

N = 10
m = 2
N-m = 8

II. PARABOLIC, GENERAL (Compute "F" statistic for correlation coeffieient)

$$tc = \frac{r^2}{1-r^2} \cdot \frac{N-m}{m-1}$$

III. LINEAR (SPECIFIC) $r^2 = 0.51185$ $r = 0.71544$
$1-r^2 = 0.48815$

$$tc = 0.715447\sqrt{8 \div 0.48815} = \underline{2.896}$$

IV. EXPONENTIAL ((SPECIFIC) $r^2 = 0.54814$ $r = 0.74036$
$1-r^2$
$= 0.45186$

$$tc = 0.74036\sqrt{8 \div 0.45186} = \underline{3.115}$$

V. PARABOLIC (SPECIFIC) $r^2 = 0.53671$ $r = 0.73260$
$1-r^2 = 0.46329$

$$F_c = \frac{0.53671}{0.46329} \cdot \frac{8}{1} = \underline{9.267}$$

VI. POWER (SPECIFIC) $r^2 = 0.50870$ $r = 0.71323$
$1-r^2 = 0.49130$

$$tc = 0.71323\sqrt{8 \div 0.49130} = \underline{2.878}$$

APPENDIX C

COMPUTATION OF "t" STATISTIC FOR REGRESSION COEFFICIENTS

COMPUTATION OF "t" STATISTIC FOR REGRESSION COEFFICIENTS

I. GENERAL

$$t_b = \frac{b}{S_b} \quad , \qquad S_b = \frac{Syx}{\sqrt{\sum (X-\bar{X})^2}}$$

where,

b = Regression Coefficient (Slope)
Syx = Standard Error of the Estimate of X on Y
S_b = Standard Error of the Independent Variable (X)
t_b = "t" Distribution Statistic for the Regression Coefficient

II. LINEAR (SPECIFIC)

$S_b = 1.48416 \div 47.6665 = \underline{0.03114}$

$t_b = 0.0902 \div 0.03114 = \underline{2.896}$

III. EXPONENTIAL (SPECIFIC)

$S_b = 0.31792 \div 47.6665 = 0.00667$

$t_b = 0.0278 \div 0.00667 = \underline{4.168}$

IV PARABOLIC (SPECIFIC)

$S_b = 1.54571 \div 47.6665 = \underline{0.03243}$

$t_b = 0.1721 \div 0.03243 = \underline{5.307}$

$t_c = -0.0013 \div 0.03243 = \underline{-0.040}$

V. POWER (SPECIFIC)

$S_b = 0.33150 \div 47.6665 = \underline{0.00695}$

$t_b = 0.4712 \div 0.00695 = \underline{67.754}$

APPENDIX D

INTERVAL ESTIMATIONS OF REGRESSION EQUATIONS

AND HYPOTHESIS TESTING

INTERVAL ESTIMATIONS OF REGRESSION EQUATIONS AND HYPOTHESIS TESTING

I. GENERAL

A. Hypothesis test for correlation coefficients using the "t" distribution table. ("F" distribution table is used for the Parabolic Function)

H_o: $r = 0$ (Null Hypothesis)
H_1: $r \neq 0$ (Alternative Hypothesis)

B. Hypothesis test for regression coefficients using the "t" distribution table. ("F" distribution table is used for the Parabolic Function)

H_o: $b = 0$, H_o: $c = o$
H_1: $b \neq 0$, H_1: $c \neq o$

C. Analysis of Variance (ANOVA) Table for Testing Significance of Regression

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	Fo
Regression	SS_R	1	MS_R	MS_R/MS_t
Error	SS_E	n-2	MS_E	
Total	SS_Y	n-1		

II. LINEAR (SPECIFIC)

A. $t_c = 2.896$ $t_t = 2.306$ Table Value (8DF, 95% confidence)

$t_c > t_t$, Therefore, we reject the null hypothesis, H_O, and accept the alternative hypothesis with a Type I error, $p = 0.05$

B. $\alpha = 0.05$, $1-\alpha/2 = 0.975$, $t_p\ (.975,8) = 2.306$

$t_b = 2.896$

$t_b > t_p$, Therefore, we reject the null hypothesis, H_o, and accept the alternative hypothesis with a Type I error, $p = 0.05$

Upper "b" limit = 0.162
Lower "b" limit = 0.018
The 95% confidence interval is,

$$0.018 \leq b \leq 0.162$$

In words, the true value of "b" lies in the interval between 0.018 and 0.162, and the statement is made with 95% confidence

C. ANOVA Table (Linear Function)

Regression	14.478	1	18.478	Fo = 8.388
Error	17.622	8	2.203	
Total	36.1	9		

$F(.05,1,8) \approx 5.32$ and we conclude that "b" is not zero at the 95% confidence level

III. EXPONENTIAL (SPECIFIC)

A. $t_c = 3.115$ $t_t = 2.306$ Table Value (8DF, 95% confidence)

$t_c > t_t$, Therefore, we reject the null hypothesis, H_O, and accept the alternative hypothesis with a Type I error, $p = 0.05$

B. $\alpha = 0.05$, $1-\alpha/2 = 0.975$, $t_p\ (.975,8) = 2.306$

$t_b = 4.168$

$t_b > t_p$, Therefore, we reject the null hypothesis, H_o, and accept the alternative hypothesis with a Type I error, $p = 0.05$

Upper "b" limit = 0.0124
Lower "b" limit = 0.0432
The 95% confidence interval is,

$$0.0124 \leq b \leq .0432$$

C. <u>ANOVA Table</u> (Exponential Function)

Regression	0.981	1	0.981	Fo = 9.705
Error	0.808	8	0.101	
Total	1.789	9		

F(.95,1,8) = 5.32 and we conclude that "b" is not zero at the 95% significance level

IV. PARABOLIC (SPECIFIC)

A. $F_c = 9.267$, $F_t = 4.26$ Table Value (F.95,2,8)

$F_c > F_t$, Therefore, we reject the null hypothesis, H_o, and accept the alternative hypothesis with a Type I error, $p = 0.05$

B. $\alpha = 0.05$, $F_p(.95,2,8) = 4.26$

$F_b = 5.307$

$F_c = ABS(0.040)$

$F_b > F_p$, Therefore, we reject the null hypothesis, H_o, and accept the alternative hypothesis with a Type I error, $p = 0.05$

$F_c < F_p$, Therefore, we accept the null hypothesis, H_o, and reject the alternative hypothesis with a Type II error, $p = 0.05$

Interval estimation is not applicable in this case.

C. ANOVA Table (Parabolic Function)

Regression	19.375	2	9.688	F = 4.055
Error	16.724	7	2.389	
Total	36.099	9		

F(.95,2,8) = 4.26 and we conclude that the regression coefficients "b" and/or "c" could be zero at the 95% significance level

V. POWER (SPECIFIC)

A. $t_c = 2.878$, $t_t = 2.306$ Table Value (8DF, 95% confidence)

$t_c > t_t$, Therefore, we reject the null hypothesis, H_o, and accept the alternative hypothesis with a Type I error, p = 0.05

B. $\alpha = .05$, $1-\frac{\alpha}{2} = 0.975$ $t_p(.975,8) = 2.306$

$t_b = 67.754$

$t_b > t_p$, Therefore, we reject the null hypothesis, H_o, and accept the alternative hypothesis with a Type I error, $p = 0.05$

Upper "b" limit = 0.4872
Lower "b" limit = 0.4552
The 95% confidence interval is,

$$0.4552 \leq b \leq 0.4872$$

C. <u>ANOVA Table</u> (Power Function)

Regression	0.910	1	0.910	F = 8.283
Error	0.879	8	0.109	
Total	1.789	9		

F(.95,1,8) = 5.32 and we conclude that "b" is not zero at the 95% confidence level

APPENDIX E

INFLATION GUIDANCE

DEPARTMENT OF THE ARMY
HEADQUARTERS US ARMY MATERIEL DEVELOPMENT AND READINESS COMMAND
5001 EISENHOWER AVE., ALEXANDRIA, VA. 22333

DRCCP-ER

28 JUL 1978

SUBJECT: Inflation Guidance

SEE DISTRIBUTION

1. References:

a. Letter, DRCCP-ER, 28 Dec 77, subject as above.

b. Letter, DRCCP-ER, 10 Mar 78, subject as above.

2. This letter furnishes new inflation indices recently finalized by OSD and DA. These revised indices should be used in the development of the FY 81-85 POM and the FY 80 Budget. Separate guidance will be issued at a later date regarding use of inflation indices in the preparation of Selected Acquisition Reports (SAR's) and Product Improvement Management Information Reports (PRIMIR's).

3. Inclosures 1-8 contain the revised inflation indices. Additional guidance is provided below:

a. RDTE (Inclosure 1). All major RDTE projects will be inflated. Major RDTE projects are defined as those systems estimated to cost $75 million or more over the life of the development. Non-major RDTE projects (less than $75 million) and the in-house salary portion of major RDTE projects will not be inflated for budget estimates. For RDTE in-house salary costs for life cycle cost estimates, the OMA rates will be used. For contract non-major RDTE, the RDTE rates will be used.

b. Procurement (Inclosures 2-6). Indices for Aircraft, Missile, Weapons and Tracked Combat Vehicles, Ammunition and Other Procurement Army (OPA) are attached. All Procurement appropriations will be inflated.

(1) Procurement of Other than Major Weapons Systems. Indices for the applicable appropriations should be applied to secondary items, modifications and product improvements. Programs not specifically covered by the tables in Inclosures 2-5 should use either the Other Procurement, Army (OPA) indices (Inclosure 6) or the related weapon system indices as appropriate, when specific data is not available. Since items of this type have a short leadtime (typically one year or less), the annual inflation rate rather than the composite rate may be used as appropriate. If the item outlay pattern follows the major item outlay, the composite rate should be used.

(2) Ammunition (Inclosure 5). Ammunition Production Base Support will be inflated as follows:

(a) For construction, indices at Inclosure 8 should be used in conjunction with local adjustment factors and guidance contained in AR 415-17, dated 9 Aug 76.

(b) For equipment procurement, Other Procurement, Army (OPA) indices and outlay rates as contained in Inclosure 6 will be used.

c. OPA (Inclosure 6). As stated previously in reference 1a, there is no separate composite index for electronics. All items, including electronic items, in the Other Procurement, Army (OPA) appropriation will use the same index.

d. OMA (Inclosure 7). As previously stated in reference 1a, OSD policy in support of Section 806 of the Defense Appropriation Authorization Act of 1977 requires Operations and Maintenance, Army (OMA) to reflect "then year" prices. The indices at Inclosure 7 will be used for that portion of the OMA Appropriation not already covered by special guidance on pay raises, AIF/ASF stabilization increases and POL prices. These indices should also be used for outyear inflation for AIF/ASF type elements of cost/budget estimates not covered by near term special guidance. However, if specific pricing guidance is issued, e.g., revised POL and cost per gallon, costs/estimates must be adjusted accordingly.

e. MCA (Inclosure 8). Inclosure 8 contains indices for military construction and new family housing appropriations. These indices should be used in conjuction with local adjustment factors and guidance contained in AR 415-17, dated 9 Aug 76. Additional guidance was contained in reference 1b.

f. MPA. Since the budgets for the military pay accounts are not inflated, rates for those accounts, which are used only in cost estimating and not program/budget documents, will not be revised at this time. Indices contained at Inclosure 7, reference 1a, will remain in effect for cost estimating purposes.

4. The following additional procedures will be followed in the application of the subject indices:

a. Cost estimates developed as input to the Army POM and budget must use the attached indices. The only exception will be where an individual program manager has specific contractual arrangements with the prime contractor through contract options or multi-year contracts. The Director of Army Budget must be advised through appropriate inflation guidance channels of all such arrangements before alternate rates are used in POM or budget submissions.

b. When there is a difference in inflation application between a budget and life cycle cost estimate, the estimate should be submitted both ways to facilitate the cost tracking process.

c. In developing life cycle cost estimates for Army systems, alternative economic assumptions, e.g., decontrol of gas and oil prices with resultant increase in POL costs to the consumer, may be used so long as the assumptions are clearly defined.

d. Foreign Military Sales (FMS). Unique rates will not normally be used for FMS. Published rates should be applied to items uniformly whether they are direct Army, FMS, or other customers.

DRCCP-ER
SUBJECT: Inflation Guidance

5. Questions relating to inflation policy should be directed to the HQ DARCOM inflation focal point, Peggy Hombs (DRCCP-ER), AUTOVON 284-9090/9105.

FOR THE COMMANDER:

8 Incl
as

THOMAS K. HIGHTOWER
LTC, GS
Executive Officer

DRCCP-ER
SUBJECT: Inflation Guidance

DISTRIBUTION:
COMMANDERS
US Army Armament Materiel Readiness Command, ATTN: DRSAR-CPE, Rock Island, IL 61299
US Army Armament Research and Development Command, ATTN: DRDAR-SEC, Dover, NJ 07801
US Army Aviation Research and Development Command, ATTN: DRDAV-BC, St Louis, MO 63166
US Army Aviation Research and Development Command, ATTN: DRDAV-PKC, St Louis, MO 63166
US Army Communications and Electronics Readiness Command, ATTN: DRSEL-CP-PR, Ft Monmouth, NJ 07703
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US Army Mobility Equipment Research and Development Command, ATTN: DRDME-CA, Ft Belvoir, VA 22060
US Army Missile Materiel Readiness Command, ATTN: DRSMI-FC, Redstone Arsenal, AL 35809
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US Army Natick Research and Development Command, ATTN: DRDNA-O, Natick, MA 01760
US Army Tank-Automotive Materiel Readiness Command, ATTN: DRSTA-EC, Warren, MI 48090
US Army Tank-Automotive Research and Development Command, ATTN: DRDTA-VC, Warren, MI 48090
US Army Tank-Automotive Research and Development Command, ATTN: DRDTA-KP, Warren, MI 48090
US Army Test and Evaluation Command, ATTN: DRSTE-CP-R, Aberdeen Proving Ground, MD 21005
US Army Troop Support and Aviation Readiness Command, ATTN: DRSTS-CC, St Louis, MO 63120
Harry Diamond Labs, ATTN: Comptroller, Adelphi, MD 20783
US Army Electronics Materiel Readiness Activity, Vint Hill Farms Station, ATTN: DRXEM-CP, Warrenton, VA 22186
US Army Electronics Materiel Readiness Activity, Vint Hill Farms Station, ATTN: DRXEM-NM-M, Warrenton, VA 22186
US Army Security Assistance Center, ATTN: DRSAC-WS, 5001 Eisenhower Ave., Alexandria, VA 22333
US Army Logistics Management Center, ATTN: DRXMC-C-SCAD, Ft Lee, VA 23801

US Army Materiel Systems Analysis Activity, ATTN: DRXSY-CR, Aberdeen Proving Ground, MD 21005
US Army Management Engineering Training Agency, ATTN: Comptroller, Rock Island, IL 61201

DIRECTORS
Materiel Management, ATTN: DRCMM-R, DRCMM-MM, and DRCMM-RS
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CHIEFS
Office of Project Management
Office of Product Improvement
DRCCP-BF
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All Product/Project Managers

OPERATIONS AND MAINTENANCE

	FY 1978	FY 1979	FY 1980	FY 1981	FY 1982	FY 1983	FY 1984	FY 1985	FY 1986
ESCALATION RATE	1.0710	1.0630	1.0600	1.0600	1.0560	1.0560	1.0560	1.0560	1.0560
BASE YEAR 1978									
COMPOUND INDICES	1.0000	1.0630	1.1268	1.1944	1.2613	1.3319	1.4065	1.4853	1.5684
COMPOSITE INDICES	1.0128	1.0760	1.1405	1.2081	1.2757	1.3471	1.4226	1.5023	1.5864
BASE YEAR 1979									
COMPOUND INDICES	.9407	1.0000	1.0600	1.1236	1.1865	1.2530	1.3231	1.3972	1.4755
COMPOSITE INDICES	.9528	1.0122	1.0729	1.1365	1.2001	1.2673	1.3383	1.4132	1.4924
BASE YEAR 1980									
COMPOUND INDICES	.8875	.9434	1.0000	1.0600	1.1194	1.1820	1.2482	1.3181	1.3920
COMPOSITE INDICES	.8988	.9549	1.0121	1.0721	1.1322	1.1956	1.2625	1.3332	1.4079

	FY 1987	FY 1988	FY 1989	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995
ESCALATION RATE	1.0560	1.0560	1.0560	1.0560	1.0560	1.0560	1.0560	1.0560	1.0560
BASE YEAR 1978									
COMPOUND INDICES	1.6563	1.7490	1.8470	1.9504	2.0596	2.1749	2.2967	2.4254	2.5612
COMPOSITE INDICES	1.6752	1.7690	1.8681	1.9727	2.0832	2.1998	2.3230	2.4531	2.5905
BASE YEAR 1979									
COMPOUND INDICES	1.5581	1.6454	1.7375	1.8348	1.9375	2.0460	2.1606	2.2816	2.4094
COMPOSITE INDICES	1.5759	1.6642	1.7574	1.8558	1.9597	2.0695	2.1854	2.3077	2.4370
BASE YEAR 1980									
COMPOUND INDICES	1.4699	1.5522	1.6391	1.7309	1.8279	1.9302	2.0383	2.1525	2.2730
COMPOSITE INDICES	1.4867	1.5700	1.6579	1.7507	1.8488	1.9523	2.0617	2.1771	2.2990

OUTLAY RATES

	1ST YEAR	2ND YEAR	3RD YEAR	4TH YEAR	5TH YEAR	6TH YEAR	7TH YEAR
1978	.8300	.1480	.0120	.0100	0.0000	0.0000	0.0000
1979	.8300	.1480	.0120	.0100	0.0000	0.0000	0.0000
1980 AND BEYOND	.8300	.1480	.0120	.0100	0.0000	0.0000	[illegible]

MILITARY CONSTRUCTION

	FY 1978	FY 1979	FY 1980	FY 1981	FY 1982	FY 1983	FY 1984	FY 1985	FY 1986
ESCALATION RATE	1.0800	1.0780	1.0700	1.0650	1.0630	1.0630	1.0630	1.0630	1.0630
BASE YEAR 1978									
COMPOUND INDICES	1.0000	1.0780	1.1535	1.2284	1.3058	1.3881	1.4755	1.5685	1.6673
COMPOSITE INDICES	1.1584	1.2354	1.3143	1.3972	1.4852	1.5788	1.6783	1.7840	1.8964
BASE YEAR 1979									
COMPOUND INDICES	.9276	1.0000	1.0700	1.1396	1.2113	1.2877	1.3688	1.4550	1.5467
COMPOSITE INDICES	1.0746	1.1460	1.2192	1.2961	1.3778	1.4646	1.5568	1.6549	1.7592
BASE YEAR 1980									
COMPOUND INDICES	.8670	.9346	1.0000	1.0650	1.1321	1.2034	1.2792	1.3598	1.4455
COMPOSITE INDICES	1.0043	1.0710	1.1395	1.2113	1.2876	1.3688	1.4550	1.5467	1.6441

	FY 1987	FY 1988	FY 1989	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995
ESCALATION RATE	1.0630	1.0630	1.0630	1.0630	1.0630	1.0630	1.0630	1.0630	1.0630
BASE YEAR 1978									
COMPOUND INDICES	1.7724	1.8840	2.0027	2.1289	2.2630	2.4056	2.5571	2.7182	2.8895
COMPOSITE INDICES	2.0159	2.1429	2.2779	2.4214	2.5739	2.7361	2.9084	3.0917	3.2865
BASE YEAR 1979									
COMPOUND INDICES	1.6441	1.7477	1.8578	1.9748	2.0993	2.2315	2.3721	2.5215	2.6804
COMPOSITE INDICES	1.8700	1.9878	2.1130	2.2462	2.3877	2.5381	2.6980	2.8680	3.0487
BASE YEAR 1980									
COMPOUND INDICES	1.5366	1.6334	1.7363	1.8456	1.9619	2.0855	2.2169	2.3566	2.5050
COMPOSITE INDICES	1.7477	1.8578	1.9748	2.0992	2.2315	2.3721	2.5215	2.6804	2.8492

OUTLAY RATES

	1ST YEAR	2ND YEAR	3RD YEAR	4TH YEAR	5TH YEAR	6TH YEAR	7TH YEAR
1978	.0400	.3600	.3000	.1500	.1000	.0500	0.0000
1979	.0400	.3600	.3000	.1500	.1000	.0500	0.0000
1980 AND BEYOND	.0400	.3600	.3000	.1500	.1000	.0500	0.0000

AIRCRAFT

	FY 1978	FY 1979	FY 1980	FY 1981	FY 1982	FY 1983	FY 1984	FY 1985	FY 1986
ESCALATION RATE	1.0680	1.0680	1.0620	1.0560	1.0540	1.0540	1.0540	1.0540	1.0540
BASE YEAR 1978									
COMPOUND INDICES	1.0000	1.0680	1.1342	1.1977	1.2624	1.3306	1.4024	1.4782	1.5580
COMPOSITE INDICES	1.1168	1.1824	1.2478	1.3153	1.3864	1.4612	1.5402	1.6233	1.7110
BASE YEAR 1979									
COMPOUND INDICES	.9363	1.0000	1.0620	1.1215	1.1820	1.2459	1.3131	1.3840	1.4588
COMPOSITE INDICES	1.0457	1.1071	1.1684	1.2316	1.2981	1.3682	1.4421	1.5200	1.6020
BASE YEAR 1980									
COMPOUND INDICES	.8817	.9416	1.0000	1.0560	1.1130	1.1731	1.2365	1.3032	1.3736
COMPOSITE INDICES	.9847	1.0425	1.1002	1.1597	1.2223	1.2883	1.3579	1.4312	1.5085

	FY 1987	FY 1988	FY 1989	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995
ESCALATION RATE	1.0540	1.0540	1.0540	1.0540	1.0540	1.0540	1.0540	1.0540	1.0540
BASE YEAR 1978									
COMPOUND INDICES	1.6421	1.7308	1.8243	1.9228	2.0266	2.1360	2.2514	2.3729	2.5011
COMPOSITE INDICES	1.8034	1.9008	2.0034	2.1116	2.2256	2.3458	2.4725	2.6060	2.7467
BASE YEAR 1979									
COMPOUND INDICES	1.5376	1.6206	1.7081	1.8003	1.8976	2.0000	2.1080	2.2219	2.3418
COMPOSITE INDICES	1.6885	1.7797	1.8758	1.9771	2.0839	2.1964	2.3150	2.4400	2.5718
BASE YEAR 1980									
COMPOUND INDICES	1.4478	1.5260	1.6084	1.6952	1.7868	1.8833	1.9850	2.0921	2.2051
COMPOSITE INDICES	1.5900	1.6758	1.7663	1.8617	1.9622	2.0682	2.1799	2.2976	2.4217

OUTLAY RATES

	1ST YEAR	2ND YEAR	3RD YEAR	4TH YEAR	5TH YEAR	6TH YEAR	7TH YEAR
1978	.0700	.4300	.2700	.1500	.0700	.0100	0.0000
1979	.0700	.4300	.2700	.1500	.0700	.0100	0.0000
1980 AND BEYOND	.0700	.4300	.2700	.1500	.0700	.0100	0.0000

RDTE

	FY 1978	FY 1979	FY 1980	FY 1981	FY 1982	FY 1983	FY 1984	FY 1985	FY 1986
ESCALATION RATE	1.0700	1.0680	1.0630	1.0580	1.0550	1.0550	1.0550	1.0550	1.0550
BASE YEAR 1978									
COMPOUND INDICES	1.0000	1.0680	1.1353	1.2011	1.2672	1.3369	1.4104	1.4880	1.5698
COMPOSITE INDICES	1.0332	1.1008	1.1676	1.2339	1.3017	1.3733	1.4489	1.5285	1.6126
BASE YEAR 1979									
COMPOUND INDICES	.9363	1.0000	1.0630	1.1247	1.1865	1.2518	1.3206	1.3932	1.4699
COMPOSITE INDICES	.9675	1.0308	1.0933	1.1553	1.2188	1.2859	1.3566	1.4312	1.5099
BASE YEAR 1980									
COMPOUND INDICES	.8808	.9407	1.0000	1.0580	1.1162	1.1776	1.2423	1.3107	1.3828
COMPOSITE INDICES	.9101	.9697	1.0285	1.0868	1.1466	1.2097	1.2762	1.3464	1.4204

	FY 1987	FY 1988	FY 1989	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995
ESCALATION RATE	1.0550	1.0550	1.0550	1.0550	1.0550	1.0550	1.0550	1.0550	1.0550
BASE YEAR 1978									
COMPOUND INDICES	1.6562	1.7473	1.8434	1.9447	2.0517	2.1645	2.2836	2.4092	2.5417
COMPOSITE INDICES	1.7013	1.7949	1.8936	1.9977	2.1076	2.2235	2.3458	2.4749	2.6110
BASE YEAR 1979									
COMPOUND INDICES	1.5507	1.6360	1.7260	1.8209	1.9211	2.0267	2.1382	2.2558	2.3799
COMPOSITE INDICES	1.5930	1.6806	1.7730	1.8705	1.9734	2.0820	2.1965	2.3173	2.4447
BASE YEAR 1980									
COMPOUND INDICES	1.4588	1.5391	1.6237	1.7130	1.8072	1.9066	2.0115	2.1221	2.2388
COMPOSITE INDICES	1.4986	1.5810	1.6680	1.7597	1.8565	1.9586	2.0663	2.1799	2.2998

OUTLAY RATES

	1ST YEAR	2ND YEAR	3RD YEAR	4TH YEAR	5TH YEAR	6TH YEAR	7TH YEAR
1978	.6000	.3200	.0700	.0100	0.0000	0.0000	0.0000
1979	.6000	.3200	.0700	.0100	0.0000	0.0000	0.0000
1980 AND BEYOND	.6000	.3200	.0700	.0100	0.0000	0.0000	0.0000

OTHER PROCUREMENT

	FY 1978	FY 1979	FY 1980	FY 1981	FY 1982	FY 1983	FY 1984	FY 1985	FY 1986
ESCALATION RATE	1.0680	1.0680	1.0620	1.0560	1.0540	1.0540	1.0540	1.0540	1.0540
BASE YEAR 1978									
COMPOUND INDICES	1.0000	1.0680	1.1342	1.1977	1.2624	1.3306	1.4024	1.4782	1.5580
COMPOSITE INDICES	1.1118	1.1775	1.2430	1.3105	1.3812	1.4558	1.5344	1.6173	1.7046
BASE YEAR 1979									
COMPOUND INDICES	.9363	1.0000	1.0620	1.1215	1.1820	1.2459	1.3131	1.3840	1.4588
COMPOSITE INDICES	1.0410	1.1025	1.1639	1.2270	1.2933	1.3631	1.4367	1.5143	1.5961
BASE YEAR 1980									
COMPOUND INDICES	.8817	.9416	1.0000	1.0560	1.1130	1.1731	1.2365	1.3032	1.3736
COMPOSITE INDICES	.9802	1.0381	1.0959	1.1554	1.2178	1.2835	1.3529	1.4259	1.5029

	FY 1987	FY 1988	FY 1989	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995
ESCALATION RATE	1.0540	1.0540	1.0540	1.0540	1.0540	1.0540	1.0540	1.0540	1.0540
BASE YEAR 1978									
COMPOUND INDICES	1.6421	1.7308	1.8243	1.9228	2.0266	2.1360	2.2514	2.3729	2.5011
COMPOSITE INDICES	1.7967	1.8937	1.9960	2.1037	2.2173	2.3371	2.4633	2.5963	2.7365
BASE YEAR 1979									
COMPOUND INDICES	1.5376	1.6206	1.7081	1.8003	1.8976	2.0000	2.1080	2.2219	2.3418
COMPOSITE INDICES	1.6823	1.7731	1.8689	1.9698	2.0762	2.1883	2.3064	2.4310	2.5623
BASE YEAR 1980									
COMPOUND INDICES	1.4478	1.5260	1.6084	1.6952	1.7868	1.8833	1.9850	2.0921	2.2051
COMPOSITE INDICES	1.5841	1.6696	1.7598	1.8548	1.9550	2.0605	2.1718	2.2891	2.4127

OUTLAY RATES

	1ST YEAR	2ND YEAR	3RD YEAR	4TH YEAR	5TH YEAR	6TH YEAR	7TH YEAR
1978	.1350	.3650	.2800	.1500	.0500	.0200	0.0000
1979	.1350	.3650	.2800	.1500	.0500	.0200	0.0000
1980 AND BEYOND	.1350	.3650	.2800	.1500	.0500	.0200	0.0000

	FY 1978	FY 1979	FY 1980	FY 1981	FY 1982	FY 1983	FY 1984	FY 1985	FY 1986
ESCALATION RATE	1.0680	1.0680	1.0620	1.0560	1.0540	1.0540	1.0540	1.0540	1.0540
BASE YEAR 1978									
COMPOUND INDICES	1.0000	1.0680	1.1342	1.1977	1.2624	1.3306	1.4024	1.4782	1.5580
COMPOSITE INDICES	1.1112	1.1767	1.2421	1.3095	1.3802	1.4547	1.5332	1.6160	1.7033
BASE YEAR 1979									
COMPOUND INDICES	.9363	1.0000	1.0620	1.1215	1.1820	1.2459	1.3131	1.3840	1.4588
COMPOSITE INDICES	1.0405	1.1018	1.1630	1.2261	1.2923	1.3621	1.4356	1.5131	1.5949
BASE YEAR 1980									
COMPOUND INDICES	.8817	.9416	1.0000	1.0560	1.1130	1.1731	1.2365	1.3032	1.3736
COMPOSITE INDICES	.9797	1.0375	1.0951	1.1545	1.2168	1.2826	1.3518	1.4248	1.5017

	FY 1987	FY 1988	FY 1989	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995
ESCALATION RATE	1.0540	1.0540	1.0540	1.0540	1.0540	1.0540	1.0540	1.0540	1.0540
BASE YEAR 1978									
COMPOUND INDICES	1.6421	1.7308	1.8243	1.9228	2.0266	2.1360	2.2514	2.3729	2.5011
COMPOSITE INDICES	1.7953	1.8922	1.9944	2.1021	2.2156	2.3353	2.4614	2.5943	2.7344
BASE YEAR 1979									
COMPOUND INDICES	1.5376	1.6206	1.7081	1.8003	1.8976	2.0000	2.1080	2.2219	2.3418
COMPOSITE INDICES	1.6810	1.7717	1.8674	1.9683	2.0746	2.1866	2.3047	2.4291	2.5603
BASE YEAR 1980									
COMPOUND INDICES	1.4478	1.5260	1.6084	1.6952	1.7868	1.8833	1.9850	2.0921	2.2051
COMPOSITE INDICES	1.5828	1.6683	1.7584	1.8534	1.9534	2.0589	2.1701	2.2873	2.4108

OUTLAY RATES

	1ST YEAR	2ND YEAR	3RD YEAR	4TH YEAR	5TH YEAR	6TH YEAR	7TH YEAR
1978	.1200	.3600	.3200	.1500	.0350	.0150	0.0000
1979	.1200	.3600	.3200	.1500	.0350	.0150	0.0000
1980 AND BEYOND	.1200	.3600	.3200	.1500	.0350	.0150	0.0000

WEAPONS/TRACK COMBAT VEHICLES

	FY 1978	FY 1979	FY 1980	FY 1981	FY 1982	FY 1983	FY 1984	FY 1985	FY 1986
ESCALATION RATE	1.0680	1.0680	1.0620	1.0560	1.0540	1.0540	1.0540	1.0540	1.0540
BASE YEAR 1978									
COMPOUND INDICES	1.0000	1.0680	1.1342	1.1977	1.2624	1.3306	1.4024	1.4782	1.5580
COMPOSITE INDICES	1.1248	1.1901	1.2556	1.3235	1.3950	1.4703	1.5497	1.6334	1.7216
BASE YEAR 1979									
COMPOUND INDICES	.9363	1.0000	1.0620	1.1215	1.1820	1.2459	1.3131	1.3840	1.4588
COMPOSITE INDICES	1.0532	1.1143	1.1756	1.2392	1.3062	1.3767	1.4510	1.5294	1.6120
BASE YEAR 1980									
COMPOUND INDICES	.8817	.9416	1.0000	1.0560	1.1130	1.1731	1.2365	1.3032	1.3736
COMPOSITE INDICES	.9917	1.0493	1.1070	1.1669	1.2299	1.2963	1.3663	1.4401	1.5179

	FY 1987	FY 1988	FY 1989	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995
ESCALATION RATE	1.0540	1.0540	1.0540	1.0540	1.0540	1.0540	1.0540	1.0540	1.0540
BASE YEAR 1978									
COMPOUND INDICES	1.6421	1.7308	1.8243	1.9228	2.0266	2.1360	2.2514	2.3729	2.5011
COMPOSITE INDICES	1.8145	1.9125	2.0158	2.1247	2.2394	2.3603	2.4878	2.6221	2.7637
BASE YEAR 1979									
COMPOUND INDICES	1.5376	1.6206	1.7081	1.8003	1.8976	2.0000	2.1080	2.2219	2.3418
COMPOSITE INDICES	1.6990	1.7908	1.8875	1.9894	2.0968	2.2100	2.3294	2.4552	2.5877
BASE YEAR 1980									
COMPOUND INDICES	1.4478	1.5260	1.6084	1.6952	1.7868	1.8833	1.9850	2.0921	2.2051
COMPOSITE INDICES	1.5998	1.6862	1.7773	1.8732	1.9744	2.0810	2.1934	2.3118	2.4367

OUTLAY RATES

	1ST YEAR	2ND YEAR	3RD YEAR	4TH YEAR	5TH YEAR	6TH YEAR	7TH YEAR
1978	.0500	.3600	.3400	.1900	.0400	.0200	0.0000
1979	.0500	.3600	.3400	.1900	.0400	.0200	0.0000
1980 AND BEYOND	.0500	.3600	.3400	.1900	.0400	.0200	0.0000

MISSILES

	FY 1978	FY 1979	FY 1980	FY 1981	FY 1982	FY 1983	FY 1984	FY 1985	FY 1986
ESCALATION RATE	1.0680	1.0680	1.0620	1.0560	1.0540	1.0540	1.0540	1.0540	1.0540
BASE YEAR 1978									
COMPOUND INDICES	1.0000	1.0680	1.1342	1.1977	1.2624	1.3306	1.4024	1.4782	1.5580
COMPOSITE INDICES	1.0967	1.1624	1.2272	1.2937	1.3636	1.4372	1.5148	1.5966	1.6828
BASE YEAR 1979									
COMPOUND INDICES	.9363	1.0000	1.0620	1.1215	1.1820	1.2459	1.3131	1.3840	1.4588
COMPOSITE INDICES	1.0269	1.0884	1.1490	1.2113	1.2767	1.3457	1.4183	1.4949	1.5757
BASE YEAR 1980									
COMPOUND INDICES	.8817	.9416	1.0000	1.0560	1.1130	1.1731	1.2365	1.3032	1.3736
COMPOSITE INDICES	.9669	1.0248	1.0820	1.1406	1.2022	1.2671	1.3355	1.4077	1.4837

	FY 1987	FY 1988	FY 1989	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995
ESCALATION RATE	1.0540	1.0540	1.0540	1.0540	1.0540	1.0540	1.0540	1.0540	1.0540
BASE YEAR 1978									
COMPOUND INDICES	1.6421	1.7308	1.8243	1.9228	2.0266	2.1360	2.2514	2.3729	2.5011
COMPOSITE INDICES	1.7737	1.8695	1.9704	2.0768	2.1890	2.3072	2.4318	2.5631	2.7015
BASE YEAR 1979									
COMPOUND INDICES	1.5376	1.6206	1.7081	1.8003	1.8976	2.0000	2.1080	2.2219	2.3418
COMPOSITE INDICES	1.6607	1.7504	1.8450	1.9446	2.0496	2.1603	2.2769	2.3999	2.5295
BASE YEAR 1980									
COMPOUND INDICES	1.4478	1.5260	1.6084	1.6952	1.7868	1.8833	1.9850	2.0921	2.2051
COMPOSITE INDICES	1.5638	1.6482	1.7372	1.8311	1.9299	2.0341	2.1440	2.2598	2.3818

OUTLAY RATES

	1ST YEAR	2ND YEAR	3RD YEAR	4TH YEAR	5TH YEAR	6TH YEAR	7TH YEAR
1978	.1100	.4900	.3000	.0500	.0480	.0020	0.0000
1979	.1100	.4900	.3000	.0500	.0430	.0020	0.0000
1980 AND BEYOND	.1100	.4900	.3000	.0500	.0480	.0020	0.0000

APPENDIX F

TABLES

"t" TABLE
"F" TABLE

"t" TABLE

d	$t_{.90}$	$t_{.95}$	$t_{.975}$	$t_{.99}$	$t_{.995}$
1	3.078	6.314	12.706	31.821	63.657
2	1.886	2.920	4.303	6.965	9.925
3	1.638	2.353	3.182	4.541	5.841
4	1.533	2.132	2.776	3.747	4.604
5	1.476	2.015	2.571	3.365	4.032
6	1.440	1.943	2.447	3.143	3.707
7	1.415	1.895	2.365	2.998	3.499
8	1.397	1.860	2.306	2.896	3.355
9	1.383	1.833	2.262	2.821	3.250
10	1.372	1.812	2.228	2.764	3.169
11	1.363	1.796	2.201	2.718	3.106
12	1.356	1.782	2.179	2.681	3.055
13	1.350	1.771	2.160	2.650	3.012
14	1.345	1.761	2.145	2.624	2.977
15	1.341	1.753	2.131	2.602	2.947
16	1.337	1.746	2.120	2.583	2.921
17	1.333	1.740	2.110	2.567	2.898
18	1.330	1.734	2.101	2.552	2.878
19	1.328	1.729	2.093	2.539	2.861
20	1.325	1.725	2.086	2.528	2.845
21	1.323	1.721	2.080	2.518	2.831
22	1.321	1.717	2.074	2.508	2.819
23	1.319	1.714	2.069	2.500	2.807
24	1.318	1.711	2.064	2.492	2.797
25	1.316	1.708	2.060	2.485	2.787
26	1.315	1.706	2.056	2.479	2.779
27	1.314	1.703	2.052	2.473	2.771
28	1.313	1.701	2.048	2.467	2.763
29	1.311	1.699	2.045	2.462	2.756
30	1.310	1.697	2.042	2.457	2.750
∞	1.282	1.645	1.960	2.326	2.576

$t_{(1-\frac{\alpha}{2}, d)}$

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F TABLE

d_1 = degrees of freedom for numerator

$d_2 \backslash d_1$	1	2	3	4	5	6	7	8	9	10
1	161.4	199.5	215.7	224.6	230.2	234.0	236.8	238.9	240.5	241.9
2	18.51	19.00	19.16	19.25	19.30	19.33	19.35	19.37	19.38	19.40
3	10.13	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81	8.79
4	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96
5	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74
6	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06
7	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	3.64
8	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39	3.35
9	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18	3.14
10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.98
11	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90	2.85
12	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80	2.75
13	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71	2.67
14	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65	2.60
15	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59	2.54
16	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54	2.49
17	4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.49	2.45
18	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46	2.41
19	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42	2.38
20	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39	2.35
21	4.32	3.47	3.07	2.84	2.68	2.57	2.49	2.42	2.37	2.32
22	4.30	3.44	3.05	2.82	2.66	2.55	2.46	2.40	2.34	2.30
23	4.28	3.42	3.03	2.80	2.64	2.53	2.44	2.37	2.32	2.27
24	4.26	3.40	3.01	2.78	2.62	2.51	2.42	2.36	2.30	2.25
25	4.24	3.39	2.99	2.76	2.60	2.49	2.40	2.34	2.28	2.24
26	4.23	3.37	2.98	2.74	2.59	2.47	2.39	2.32	2.27	2.22
27	4.21	3.35	2.96	2.73	2.57	2.46	2.37	2.31	2.25	2.20
28	4.20	3.34	2.95	2.71	2.56	2.45	2.36	2.29	2.24	2.19
29	4.18	3.33	2.93	2.70	2.55	2.43	2.35	2.28	2.22	2.18
30	4.17	3.32	2.92	2.69	2.53	2.42	2.33	2.27	2.21	2.16
40	4.08	3.23	2.84	2.61	2.45	2.34	2.25	2.18	2.12	2.08
60	4.00	3.15	2.76	2.53	2.37	2.25	2.17	2.10	2.04	1.99
120	3.92	3.07	2.68	2.45	2.29	2.17	2.09	2.02	1.96	1.91
∞	3.84	3.00	2.60	2.37	2.21	2.10	2.01	1.94	1.88	1.83

$F(.95, d_1, d_2)$